(No Model.)

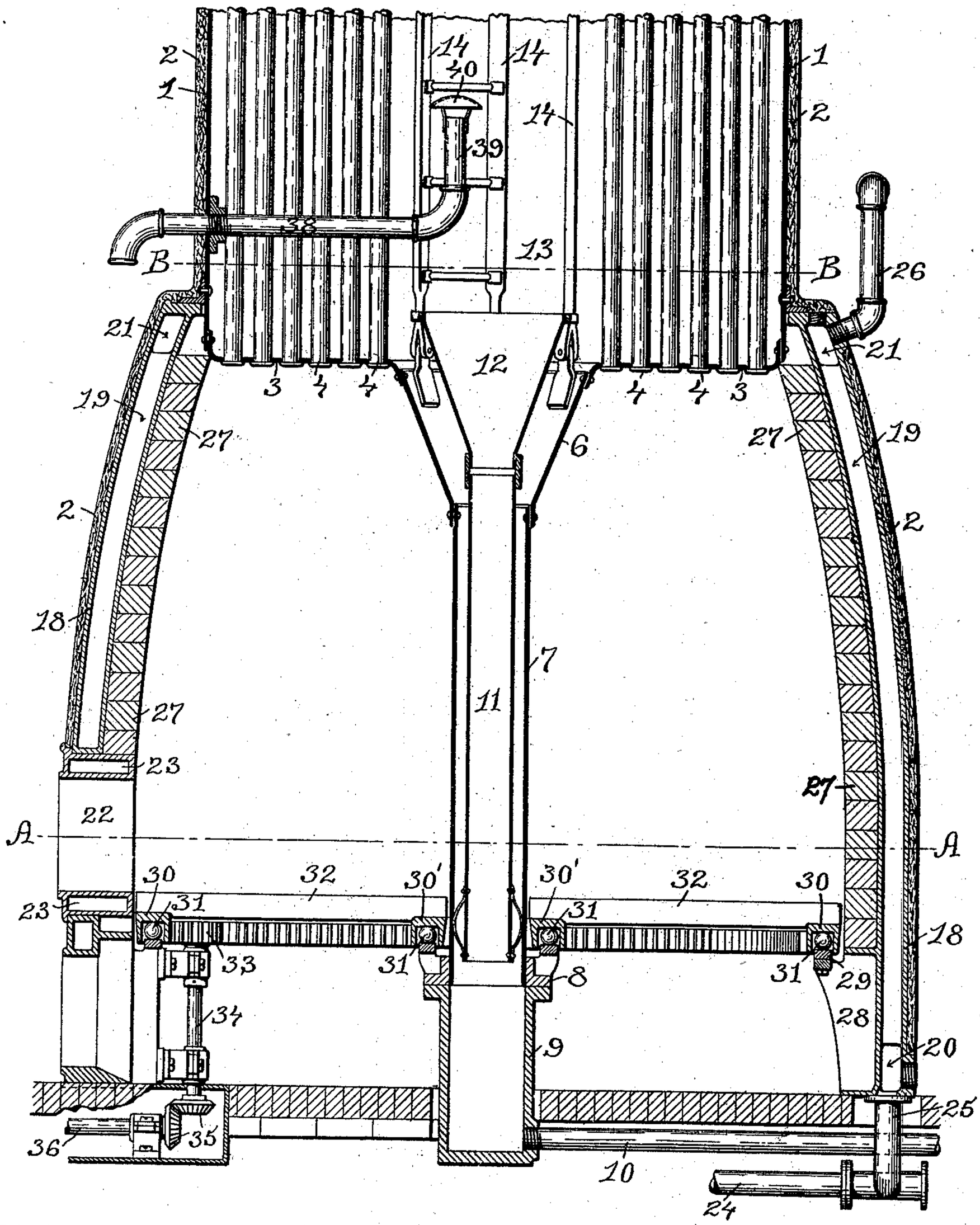
3 Sheets—Sheet 1.

D. M. THOMPSON.

STEAM GENERATOR.

No. 559,151. Patented Apr. 28, 1896.

Fig. 1.



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(No Model.) 3 Sheets—Sheet 2.

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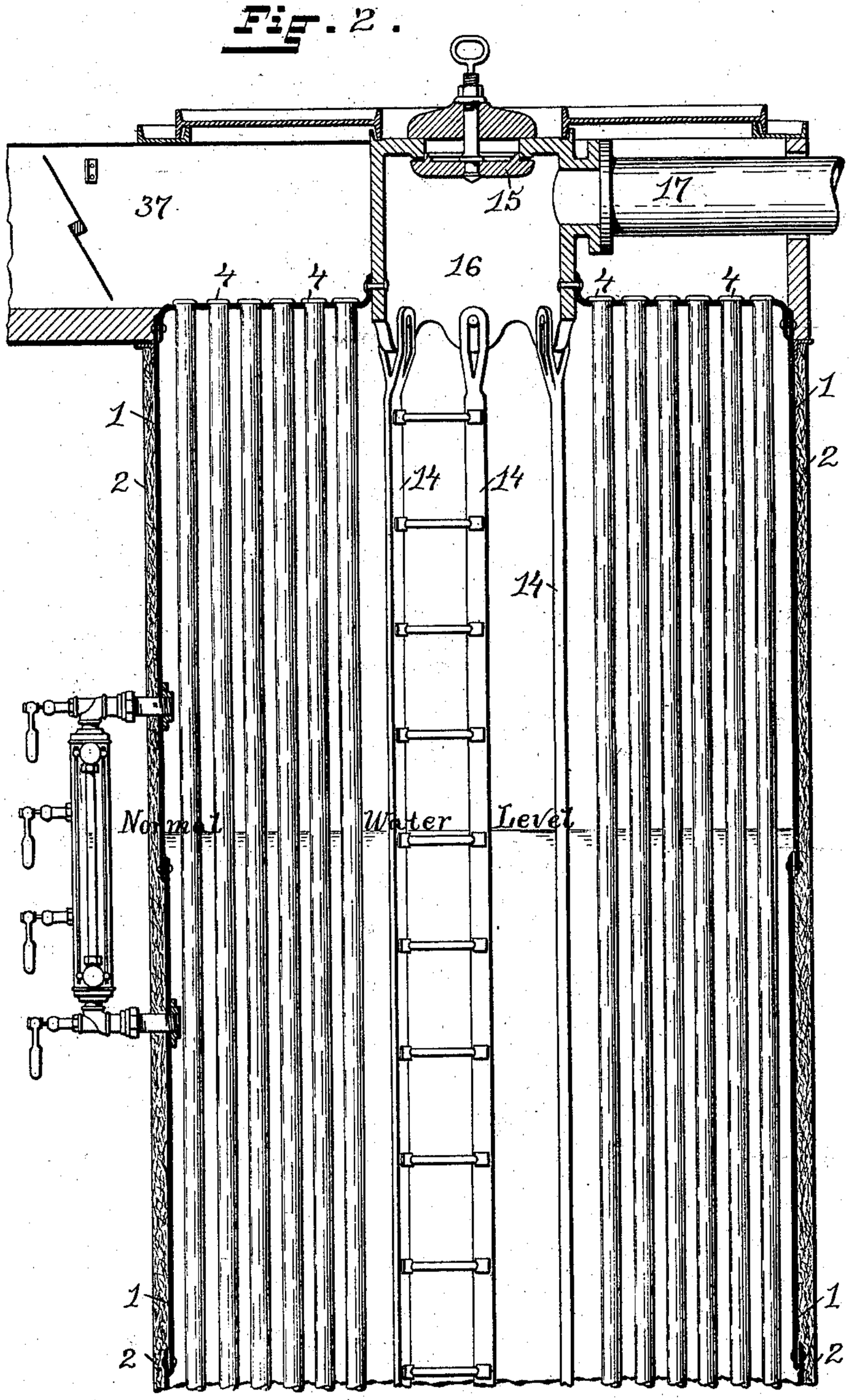
Fig. 2.



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(No Model.) 3 Sheets—Sheet 3.

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Fig. 3.

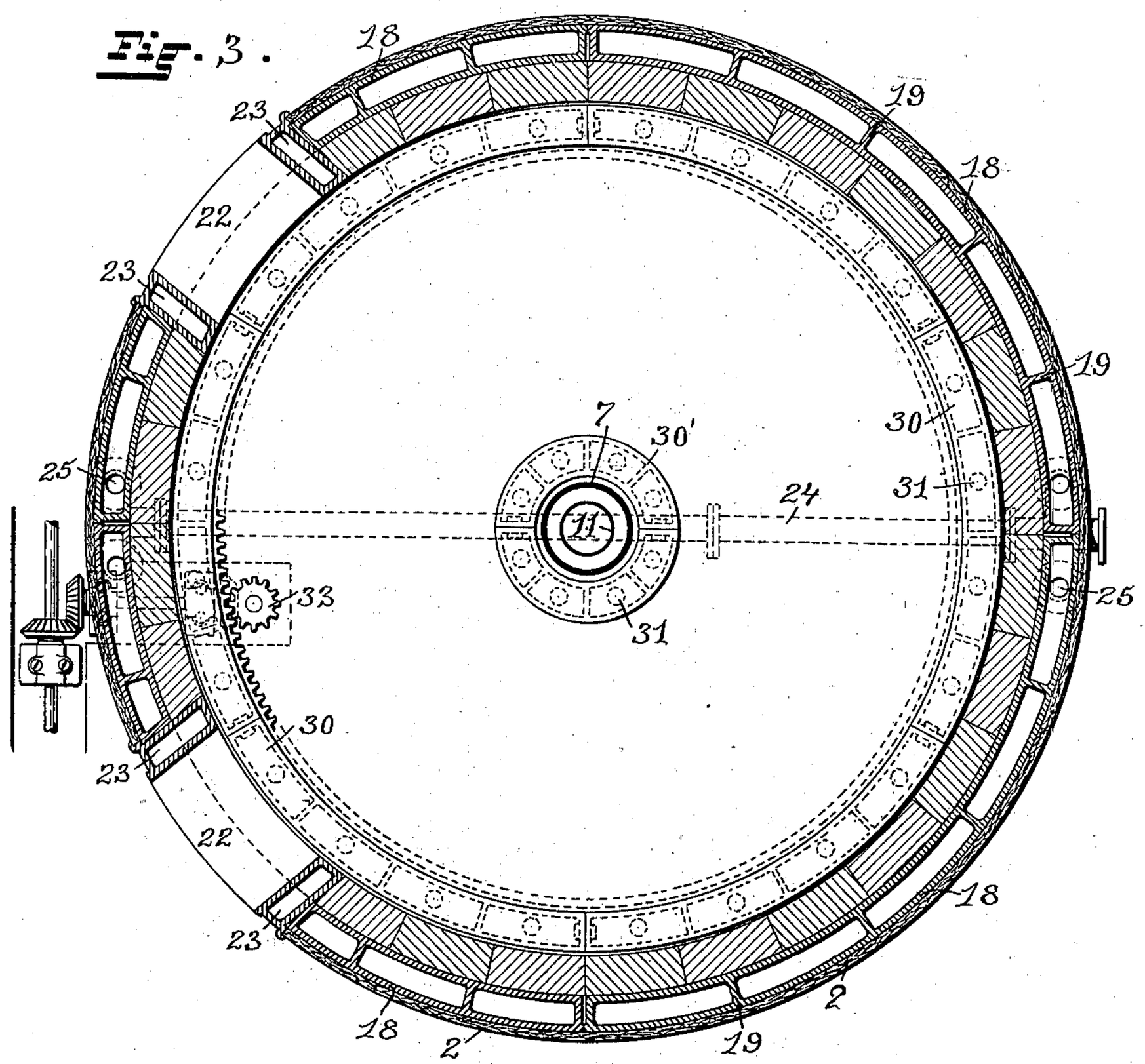
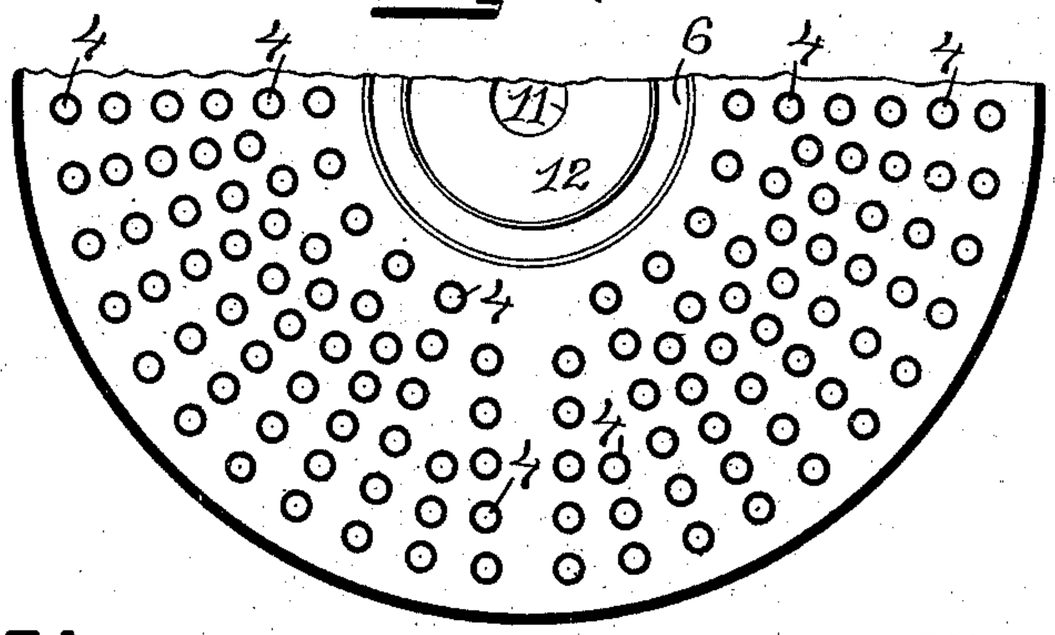


Fig. 4.



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UNITED STATES PATENT OFFICE.

DAVID M. THOMPSON, OF PROVIDENCE, RHODE ISLAND.

STEAM-GENERATOR.

SPECIFICATION forming part of Letters Patent No. 559,151, dated April 28, 1896.

Application filed October 16, 1895. Serial No. 565,840. (No model.)

To all whom it may concern:

Be it known that I, DAVID M. THOMPSON, of the city of Providence, in the county of Providence and State of Rhode Island, have invented certain new and useful Improvements in Steam-Generators; and I hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming part of this specification.

This invention has reference to an improvement in vertical tubular steam-generators in which a vertical cylindrical shell provided with tubes is supported above a circular furnace, so that the products of combustion pass vertically through the tubes, and is particularly well adapted for the class of vertical tubular steam-generators in which a water-leg extends from the cylindrical shell centrally downward through the center of the furnace.

Vertical tubular steam-generators require to be supported above the furnace, and in the most common form they are supported by extending the shell down below the furnace and forming this portion of the shell into a water-surrounded fire-box. The water-space forming the fire-box being part of the boiler is subjected to the full steam-pressure and the pressure incident to the height of the column of water in the whole boiler. The inner shell cannot withstand this pressure and requires to be stayed by connecting it to the outer shell by stay-bolts placed at frequent intervals. The fire-box so constructed contracts the area of the grate, is costly, and the weakest part of this class of steam-generators. This class of steam-generators is also supported frequently on brick walls, which inclose the furnace. These are objectionable on account of continual expansion and contraction of the walls and the great loss of radiated heat from the same. While for the generation of steam for power exerted through a modern compound steam-engine the vertical boiler has many advantages, it is desirable to materially increase the grate area to facilitate the perfect combustion of even a low quality of fuel and adapt this class of boilers for the use of any kind of water, even the inferior water containing lime and other impurities.

The object of this invention is to provide a furnace for vertical tubular steam-generators which prevents the loss of the heat by utilizing the same, secures a larger grate area for the furnace, a refractory surface around the fire to facilitate the combustion of the fuel before the gases enter the tubes, and a firm, reliable support for the vertical tubular boiler.

Another object of the invention is to secure more perfect combustion of the fuel and better control of the fire in a vertical tubular steam-generator.

Figure 1 is a vertical sectional view of the lower part of a vertical tubular boiler provided with my improved furnace. Fig. 2 is a vertical sectional view of the upper part of the steam-generator. Fig. 3 is a horizontal sectional view of the furnace on the line A A, Fig. 1; and Fig. 4 is a horizontal sectional view of one-half of the vertical tubular steam-generator on the line B B in Fig. 1.

Similar numerals of reference designate corresponding parts throughout.

In the drawings, 1 indicates the cylindrical shell of the steam-generator; 2, the covering composed of some slow conductor of heat; 3, the lower tube-sheet; 4 4, the tubes; 6, a truncated conical cylinder which connects the lower tube-sheet 3 with the central tube 7, the lower end of which is secured to the flanged socket 8, which is in its turn secured to the nut-drum 9, with the lower end of which the blow-off pipe 10 is connected. Within the central tube 7 is placed the tube 11, provided at its upper end with the funnel-shaped conical tube 12. By this arrangement the central portion of the tube-sheet is supported and rapid circulation of the water in the central tube 7 is secured, the water in the annular space between the tube 7 and the tube 11 is subjected to the heat of the furnace, the heated water rises in this annular space and is replaced by the water descending through the interior tube 11, and impurities held in suspension by the water are precipitated into the mud-drum 9 and are readily blown out by means of the blow-off pipe 10.

To facilitate the circulation of the water, the internal inspection of the generator, and the thorough cleaning of the same, the circular well 13 is formed and the ends of the generator are stayed by means of the rods 14. One pair of these rods is made into a ladder

by securing rungs to them, as is shown in Figs. 1 and 2, and access to this central well is secured through the manhole 15, placed in the end of the steam-dome 16, from which the steam-pipe 17 carries the steam to the engine. To facilitate the thorough cleaning of the interior of the generator, the tubes 4 4 are placed in radial lines, as is shown in Fig. 4, so that every part of the surface of the tubes can be reached from the central well 13.

The main support of the vertical tubular generator consists of a circular cellular casing made up of sections 18, curved so as to form a dome-shaped base for the generator. The sections 18 are divided by the vertical ribs 19 into vertical cells, and these are connected at the bottom by the openings 20 and at the top by the openings 21. In the sections 18 of the casing the firing-openings 22 are formed and these are surrounded by the cellular casings 23, connected by openings with the cellular spaces in the sections 18. Water is supplied to the cellular spaces in the casing through the pipe 24, from which the branch pipes 25 extend to the lower part of each section, as shown in Fig. 1. The upper ends of the sections are connected by the pipes 26 with a pump by which the heated water is supplied to the vertical tubular generator.

The water may be supplied to the cellular casing by means of a pump, or it may be supplied from a tank located above the casing, provided with an automatic supply-cock, and the heated water from the casing may also be delivered into a tank placed on the same level with the supply-tank, so that in the normal condition the connections between the supply and the delivery tanks are always open and the casing is never subjected to a higher pressure than that incident to the static pressure of the column of water.

The interior of the casing is lined with the fire-brick resting on a circular rim extending inward from the casing and strengthened by the vertical ribs 28, which also form the support for the outer circular grate-bearing rim 29, on which the outer grate-bearers 30 are supported by the balls 31. The grates 32 rest on these outer bearers 30 and on the inner bearing-ring 30′, which is also supported on similar ball-bearings.

Economy in fuel and the efficiency of a steam-generator depend largely on the skill of the fireman to keep the grates clear and supply the fuel evenly over the whole grate in the shortest time, for every moment the fire-door is open large quantities of air rush into the generator and reduce the temperature.

In vertical tubular boilers it is difficult to clean the grate and evenly distribute the fuel unless at least three firing-doors are provided and these are successively opened. When a number of such boilers are used in one building, a large space has to be left free around these boilers, so as to handle the slicing-bar and the shovel. This is, in many cases, impractical, and to overcome this difficulty I construct the grate-surface so that it slowly revolves and all parts can be reached from one firing-opening. With such a construction any required number of vertical generators can be set close together side by side or placed close together in a group, and to this end I provide the circular bearing-bar 30 with gear-teeth and connect the pinion 33, which is secured to the vertical shaft 34, with the same. The vertical shaft 34 is connected, by means of the pair of beveled gears 35, with the shaft 36, to which motion is imparted from some prime motor. The gearing is for the sake of clearness shown on the inner side of the cylindrical bearer 30, but may in practice be placed on the outer periphery and the pinion 33 and shaft 34 be placed into a space made for the same in the cellular casing 18, provided with a door.

The vertical tubular cylinder is firmly supported on the circular arched casing by brackets or a flanged ring riveted near the lower end to the cylindrical shell, as is shown in Fig. 1, giving to the same, by reason of the enlarged base, a very firm and substantial support. The dome-shaped inwardly-curved furnace lined with refractory material secures a large grate area and a large combustion-chamber in which the gaseous products of combustion are maintained at a high temperature in a space vastly larger than the combined area of the tubes therefor for a sufficient length of time to secure perfect combustion of the gases before they pass into the tubes, where they give up their heat to the water in the generator, and after passing through the portion of the tubes above the water-line, where they dry and somewhat superheat the steam, they pass into the uptake 37 and on to the chimney.

The fire-brick lining 27 of the furnace, while it maintains the high temperature of the furnace and is but a slow conductor of heat, conducts all the heat, ordinarily lost, into the water in the cellular casing. Thereby the loss by radiation is reduced to the lowest point, the waste heat is utilized, and the casing protected against injury by heat.

The feed-water for the generator is taken from the upper part of the casing or the delivery-tank and is supplied through the pipe to the discharge-pipe 39, the upper open end of which is protected by the hood 40.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. In a vertical tubular steam-generator, the combination with the cylindrical shell, the end tube-sheets, the tubes placed on radial lines, and the central well, of the conical cylinder 6, the tube 7, the mud-drum 8 provided with the blow-off pipe 10, the circulating-tube 11 provided with the funnel-shaped

end 12, and the feed-water-supply pipes 38 and 39 having the outlet protected by the cap 40, as described.

2. The combination with a vertical tubular steam-generator, of a cellular casing, disconnected from the steam-generator and provided with water-supply inlets and hot-water outlets, constructed to form the support of the generator and inclosure for the furnace, as described.

3. The base for a vertical tubular steam-generator, consisting in a number of cellular segmental sections connected at the top and bottom to form a continuous water-space, lined on the inner surface with a refractory material, as described.

4. In a steam-generator in combination a vertical cylindrical shell, an annular group of tubes surrounding a central open well within the cylindrical shell, a steam-dome extending above the upper tube-sheet and provided with a steam-outlet and a manhole, a central column connected with the lower tube-sheet and extending below the grate, a cellular casing constructed to support the cylindrical shell and inclose the furnace, a circular grate, and mechanism for rotating the same, a feed-water pipe connected with the cellular casing, a hot-water outlet for the cellular casing, a feed-water pipe connected with the central column, and connections, between the hot-water outlet from the cellular casing and the feed-water pipe supplying the central column, whereby the feed-water supplied to the cellular casing is heated and delivered to the steam-generator, as described.

5. The combination with a vertical tubular steam-generator, a central cylindrical extension from the lower tube-sheet to a mud-drum below the grate-surface, of an annular fire-box provided with an opening for supplying fuel, the annular grate 32, the ring-shaped bearing-bars 30 and 30′ supported on bearing-balls, and a gear-and-pinion mechanism for rotating the grate, as described.

6. In a base forming the furnace and support for a vertical steam-generator, the combination with the sections 18 vertically divided by the ribs 19 into cellular water-spaces, the openings 20 and 21, the brackets 28, the supporting-ring 29, the channeled bearing-bars 30, the balls 31, the grates 32, and the fire-brick lining 27; constructed to heat the feed-water before it is supplied to the steam-generator, as described.

In witness whereof I have hereunto set my hand.

D. M. THOMPSON.

Witnesses:
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JOSEPH A. MILLER, Jr.